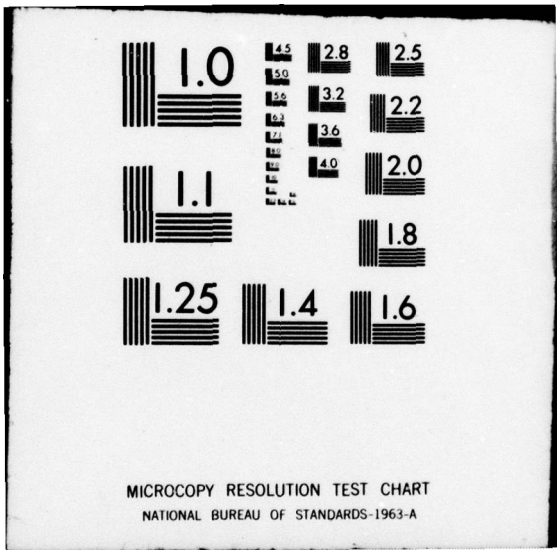
AD-A065 568 ANALYTIC SERVICES INC ARLINGTON VA F/G 6/12
PREPARATION FOR AND IMPLEMENTATION OF AUTOMATED HOSPITAL INFORM--ETC(U)
JAN 79 J D HODGDON, D J HUTCHINSON F49620-77-C-0025
UNCLASSIFIED ANSER-HSSEDN-79-1 NL

1 OF
AD
A065568

END
DATE
FILMED
5-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

LEVEL II

HEALTH SYSTEMS STATISTICS AND EVALUATION
DIVISION NOTE

HSSEDN 79-1

PREPARATION FOR AND IMPLEMENTATION OF AUTOMATED HOSPITAL INFORMATION SYSTEMS

January 1979

Jonathan D. Hodgdon
Daniel J. Hutchinson

Approved by
P. W. Blackmon, Division Manager

anser Analytic Services Inc.

This Division Note reports results of research sponsored by the *Directorate of Medical Plans and Resources, Office of the Surgeon General, Headquarters United States Air Force,* under *Contract F49620-77-C-0025.* However, the results do not necessarily represent the official views of the Sponsor.

ANSER was established in 1958 as an independent, not-for-profit research corporation to contribute to the security and public welfare of the United States. ANSER's principal activity is to provide government agencies with objective, timely research and unbiased recommendations on complex technical and management problems. The ANSER staff contributes directly and significantly to problem solving in the public interest through systems analysis and evaluation, operations research, investigation of technical feasibility, and development and application of planning methods.

LEVEL II

(9) HEALTH SYSTEMS STATISTICS AND EVALUATION DIV. NOTE,

HSSEDN 79-1

(6) PREPARATION FOR AND IMPLEMENTATION OF AUTOMATED HOSPITAL INFORMATION SYSTEMS.

(11) Jan 79

(12) 68p.

(10) Jonathan D. Hodgdon
Daniel J. Hutchinson

(15) F49620-77-C-0025

(14) ANSER-HSSEDN-79-1

Approved by
P. W. Blackmon, Division Manager

ACCESSION for	
NTIS	White Section
DDC	Buff Section
UNANNOUNCED	
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
Dist.	AVAIL. and/or SPECIAL
A	

Approved for public release; distribution unlimited.

DDC RECEIVED MAR 13 1979 D

anser Analytic Services Inc.
400 Army-Navy Drive, Arlington, Virginia 22202

029 470

79 03 08 032

CONTENTS

CONTENTS (Cont.)

I. INTRODUCTION

A. Purpose and Rationale

The purpose of this report is to assist military health care system managers at all levels in ensuring successful implementation of automated information systems in military medical treatment facilities (MTFs).

The implementation of an automatic data processing (ADP) system in a hospital is a major undertaking for system planners, managers, and users at the facility. Many system failures in the past have been attributed to inadequate user preparation and consultation rather than to problems of technical design. Among hospitals that have successfully introduced automated operations, many have had to endure a lengthy and costly shakedown period of system inefficiency and many have never realized the full potential of the system. The report will emphasize: 1) positive benefits of a computer system that may not be immediately realized; 2) negative impacts of a computer system that require careful preparation to avoid; 3) procedural and interpersonal rather than economic impacts of automation; and 4) management strategies for improving functional rather than technical system performance. While we assume in this report that the transfer is being made from manual to automated procedures, most of the impacts and strategies discussed apply to the process of adopting any new information system.

The remainder of this chapter outlines the basic concepts and relationships associated with ADP systems and the process of change, and Chapter II describes the characteristic impacts (both positive and negative) of an ADP system on the overall operation of the affected department(s), the hospital as a whole, and on the various categories of personnel within the

hospital. Chapter III discusses the problem of resistance to change and its implications and presents some strategies for minimizing problems that might occur either before or soon after the installation of the new system. Chapter IV identifies sources of unused system potential that may exist after the system has stabilized and outlines some post-implementation management strategies for realizing the full potential of the ADP system. Finally, Chapter V presents a brief summary.

B. Description of Concepts

1. The Automated Hospital Information System

The most common type of computerized information system in hospitals, according to Barnett and Zielstorff, is an "*ancillary area support system*, which is aimed at improving the information-related activities of individual service units such as the pharmacy, the clinical laboratories, the radiology department, or the admitting office" (Ref. 1, page 157). Most of these ancillary systems may be described as being patient-care oriented with similar departmental impacts; however, a few, such as a food service ADP system, have had more unique impacts on the health care providers (physician and nursing staffs) and patients. A second type of hospital information system is *a transactional system*, which is "primarily concerned with financial management and concentrates on recording the use of services or goods for the purpose of billing" (Ref. 1, page 157). Such management-oriented information systems also have minimal effects on the hospital professional staffs and are, therefore, treated separately in Chapter II of this report. Finally, we will consider the impacts of the third and larger type of system—*the hospital-wide system*, often referred to as a Medical Information System (MIS) or Hospital Information

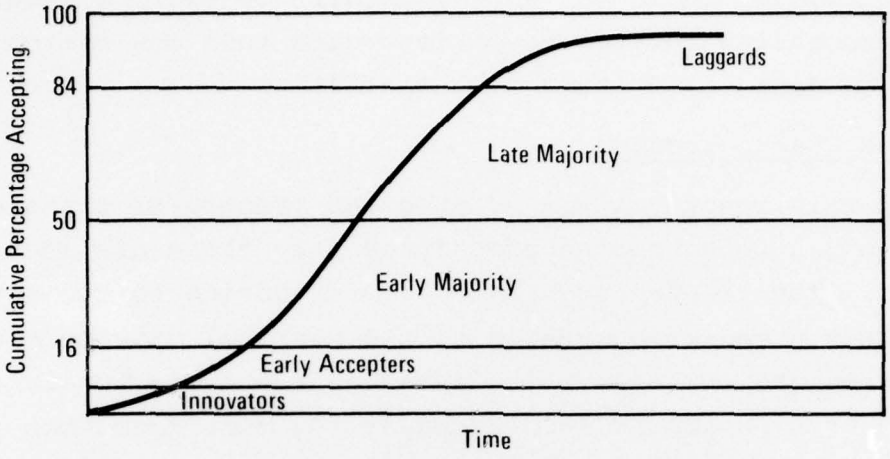
System (HIS). The HIS "focuses on transmitting data among various personnel in different support units of the hospital" and ultimately seeks to "integrate all elements of information processing related to patient care into one system with a shared data base" (Ref. 1, page 158).

2. The Change Process

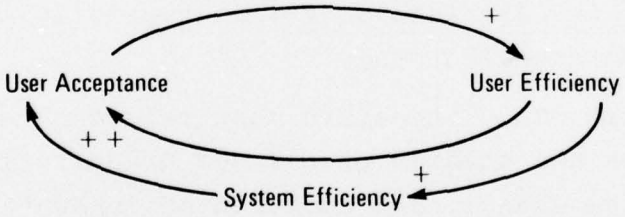
In this report we will divide the process of transfer from manual to automated procedures into three distinct phases. The *pre-implementation period* refers to the time from when preparations begin at the hospital site to the time when the ADP system is installed and operational. The *implementation period* is defined as the time from when the system is installed and operational to the time when the system has stabilized and the users have reached a high level of proficiency with and acceptance of the ADP system (typically, the first 12 months of computerized operations). Soon after stabilization the system usually undergoes a period of evaluation and modification, which we will refer to as the *post-implementation period* (typically 1 to 3 years after system installation).

The background literature most relevant to this report are theories and studies of planned organizational change, resistance to change, and adoption of innovations, good discussions of which may be found in Bennis (Ref. 2), Havelock (Ref. 3), Whisler (Ref. 4), and Zaltman, et al., (Ref. 5). Only the general concepts and relationships necessary for understanding the change process will be described here and in Chapter III. After installation of the ADP system, the pattern of user acceptance, user efficiency, and system efficiency all follow the general form of the S-shaped curve depicted for acceptance in Figure 1.

FIGURE 1
ACCEPTANCE PLOTTED AS A CUMULATIVE CURVE*



The importance of user acceptance to system performance can be seen by the following interrelationships:



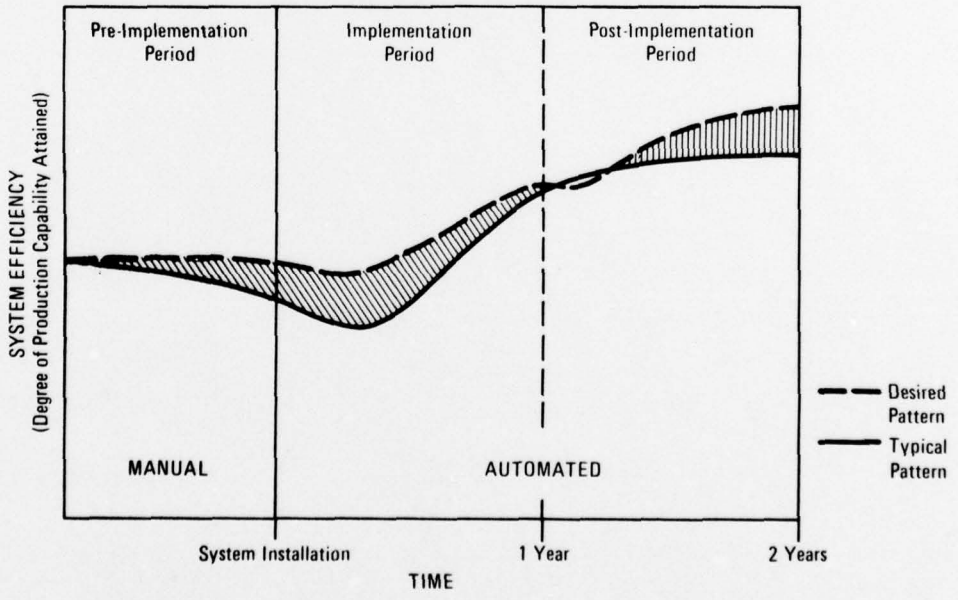
As system efficiency improves, user attitudes toward the system will become more favorable. As user acceptance increases, user efficiency should subsequently improve, which

---

* Ref. 3, Chapter 10, page 9. Studies supporting the contention that acceptance is normally distributed are reviewed in Rogers, Diffusion of Innovations, 1962, page 367.

results in further increases in both system efficiency and user acceptance. The time required for these variables to stabilize at a high level depends on: 1) the amount and quality of management action and direction provided before, during, and after system implementation; 2) the technical and functional superiority of the automated system relative to the previous system; 3) the users' *readiness for change*, defined as the extent to which the existing system fails to meet their needs, combined with the extent to which the users have been trained and educated concerning automated procedures; and 4) the acceptability of related changes in tasks or supervision that often accompany new systems. The objective of this report is to provide management guidelines not only for minimizing implementation problems and the time required for system stabilization, but also for raising the level at which system performance will ultimately stabilize. Figure 2 compares a typical pattern of system stabilization with the pattern that should result from incorporating the strategies

FIGURE 2
DESIRED VERSUS TYPICAL ADP SYSTEM STABILIZATION



outlined in this report. The shaded regions indicate the potential cost savings (in terms of higher production capability) to be derived from the improved system efficiency within all three time periods. In this depiction, desired system performance temporarily drops slightly below typical system performance as a result of major hardware, software, and/or procedural modifications implemented after 1 year in order to raise the level at which system efficiency may ultimately stabilize.

REFERENCES

1. Barnett, G. O., and Zielstorff, R. N., "Data Systems Can Enhance or Hinder Medical, Nursing Activities," Hospitals, Vol. 51, October 16, 1977.

2. Bennis, W. G., Changing Organizations, New York: McGraw-Hill, 1966.

3. Havelock, R. G., Planning for Innovation, Ann Arbor: The University of Michigan Press, 1976.

4. Whisler, T. L., Information Technology and Organizational Change, Belmont, Calif: Wadsworth Publishing Co., 1970.

5. Zaltman, G., Duncan, R., and Holbek, J., Innovations and Organizations, New York: Wiley and Sons, Inc., 1973.

II. CHARACTERISTIC ADP IMPACTS

This chapter focuses on the procedural and interpersonal impacts of adopting a new information system; discussion of other types of impacts (e.g., economic or logistical) would exceed the purpose and scope of the report. Section A deals with the effects of automation on the overall operation of the hospital organization; Section B separates the impacts of most ADP systems into impacts on various categories of personnel; and Section C briefly describes the impacts associated with other, more unique, ADP systems.

A. General Discussion

The magnitude of an ADP system's impact on the individual and on the organization as a whole increases with the degree to which the individual must directly use the system or its products and with the size of the system. The kinds and amount of contact with the system determine the magnitude of its impacts on individuals. The size of the system determines the number of people affected and thus the magnitude of the impact on the organization as a whole. Thus, a comprehensive, hospital-wide system can impact the hospital's ability to accomplish its mission, while an ancillary system will impact the internal operations of the ancillary service involved but may have only minimal impact on the overall organization. In considering the effect of automation on the organization as a whole, impacts will be divided into three general types: 1) temporary; 2) long-term positive; and 3) long-term negative.

1. Typical Temporary Impacts

The introduction of advanced information technology into an organization necessitates structural and procedural changes; namely, changes in work methods, information flows, organizational relationships, and responsibilities for decisions

(Ref. 6). Long-term impacts of these changes may be positive or negative (see Sections IIA2 and IIA3) and are usually recognized after the system has stabilized. Some temporary negative impacts, however, can be expected to occur during system implementation. These impacts should be short-lived and have minimal effect on the organization beyond the implementation phase. Some examples of these temporary impacts of procedural changes are:

- Manual and automated duplication of effort. While an ADP system is being implemented, it is common for many information-processing tasks to be performed using both manual and automated procedures. The amount of such duplication will decrease as implementation and staff training progress, and it should eventually be eliminated. Some duplication may continue beyond the implementation phase if there are staff members who do not trust the system or fail to develop confidence in their ability to use it.

- Reduced individual efficiency. Individuals who have developed a certain level of expertise in the manual system must learn the new procedures and techniques required by an automated system. Efficiency will be temporarily reduced until the individuals become fully familiar with the new system.

- Reduced organizational efficiency. It is not uncommon for the efficiency of an organization to temporarily decrease after the installation of an automated system. This can be attributed to several factors:

  - Staff unfamiliarity with the system
  - Computer malfunction—software and hardware

- Unanticipated additional requirements that must be integrated into the system
- Gradual adjustment to increased workload.

- Required staff overtime. Staff members have additional responsibilities during implementation of an automated system. Not only must they continue their duties that were necessary under the manual system, but they must also learn the new techniques required by the automated system. Additional time is needed to refine clerical and administrative procedures and to enter data base information (e.g., patient profiles, patient registration data, drug inventories) into the system. Many of these additional procedures must be accomplished outside of normal working hours so that they do not interfere with everyday operations.

- Patient registration delays. Automated information systems can process more patient demographic information than manual systems. However, this capability requires that additional information be obtained from patients, usually when they first visit the hospital after the system is installed. Because most patients will be required to provide this additional information for a recently installed system at roughly the same time, registration delays may develop. However, once the majority of the patient population has been registered, this impact should be significantly reduced.

2. Typical Long-Term Positive Impacts

ADP systems are intended to positively affect patient care through improved information processing and communication. Some common positive impacts of automation on patient care are:

- Improved documentation. Automation frequently acts to ensure complete and accurate documentation of a patient's clinical course and treatment. Completeness is a requirement for entering data into the system, and the system displays remind users of standard procedures and to attend to and record all facets of patient management information. The system also has the capabilities to print out new types of reports and provide information on a more frequent basis.

- Improved methods of detecting and reporting abnormalities. Identification of abnormalities is essential to the proper treatment of the patient. Under manual procedures, the technician usually makes little effort to identify abnormal results since this is primarily a responsibility of the health care provider; instead, technicians transcribe test results onto the appropriate forms without additional comment. Automated systems, such as laboratory or radiology systems, are programmed to detect abnormalities and display these abnormalities so that they are brought to the immediate attention of the physician. The abnormality is usually denoted with an asterisk and by printing a scale of normal values for results of the specified test.

- Improved accuracy and legibility of reports and orders. Most systems do not allow inaccurate or incomplete data to be processed. Final results/reports are produced mechanically in conveniently formatted, typed computer printouts, thereby reducing the possibility of transcription errors as well as interpretation errors due to illegibly written results. Data may often be accessed directly (online) by using mark

sense cards/video terminals. With a hospital-wide system, the accuracy and legibility of orders as well as reports should improve, since the process of ordering tests is also done through the computer terminals.

- Improved organization and filing of data. An automated system with printout capability should make results of patient treatment easier to read and may reduce individual recognition time during filing and sorting. Cumulative reports may combine results of several procedures, reducing the number of forms that require filing. Results may also be filed into a central data base, thereby decreasing the number of files that must be maintained.

- Improved ability to handle peak workloads. Because automated systems are less labor-intensive than manual systems, the ADP systems have greater flexibility for handling increases in workload. That is, they can accommodate seasonal and daily variations in workload with less alteration of staffing levels. This should enable the hospital staff to deal more effectively with peak workloads.

- Improved job satisfaction of some staff members. As previously stated, automation will produce changes in work methods, information flows, responsibilities for decisions, and organizational relationships. These changes should have an overall positive effect on the organization and on certain staff members within the organization. It is therefore possible that individuals whose jobs are most affected by these positive impacts will experience a higher degree of job satisfaction with the automated system.

3. Typical Long-Term Negative Impacts

The introduction of an ADP system into a hospital environment may also have associated negative impacts. According to Barnett "one of the most troublesome results of more sophisticated technology is that an automated information system may be used as an excuse for incompetent or irresponsible behavior" (Ref. 2, page 160). Individuals may try to cover up their inadequacies on the job by transferring the blame for their substandard performance to the computer. Examples of other potential negative impacts include:

- Increased dependence on the computer. While automation tends to reduce the day-to-day commotion brought about by sudden increases in patient workload, it may be replaced by an equally undesirable instability. The users become increasingly dependent on the ADP system over time, and unless the reliability of the computer hardware and software keeps pace with this increasing dependence, pandemonium can result even without exceptional levels of patient demand for services. Where an adequate backup system does not exist, and where the ADP terminals are connected long-distance with the main computer, this increased dependence can be a particular problem (Ref. 3, page 24).

- Feeling of decreased job security and lost status. As pointed out by Sanders (Ref. 7, page 236), many individuals view the computer as a threat to their employment. Even after the system has been installed and their initial fear of being replaced has diminished, their self-confidence may be shaken by a lack of knowledge about and experience with the new system. They may fear that they will not be able to acquire

the new skills necessary to work with the system. The technical computer terminology often used by the computer specialists during implementation may increase employees' fear of the system and further reduce their self-confidence. Supervisory personnel may feel that their status in the organization will be diminished because of a possible reduction in the number of employees under their supervision as a result of automation.

- Decreased ability to handle special processing demands. Automated information systems process high volumes of data using specific, well-defined protocols. It is infeasible to program a computer to handle every situation that may arise. Therefore, a special case or an unusual circumstance must be handled on an individual basis. This usually requires a disproportionate amount of time and effort by the staff.

- Decreased job satisfaction of some staff members. The procedural changes that accompany an ADP system are likely to make some employees' jobs easier and others' jobs more difficult. Hence, while the job satisfaction of some staff members may increase, the satisfaction of others may decrease. Another major reason for decreased job satisfaction is that employees may feel that their talents for creativeness and decisionmaking have been curtailed by the ADP system.

Finally, another common impact of automation on the overall organization (which may be either positive or negative) is that the ADP system tends to serve as a *catalyst for change* within the affected hospital areas (Ref. 4, page 149). Some changes in work methods, information flows, and supervision are necessitated by the new system (see Section IIIC1);

however, hospital administrators may also voluntarily institute other previously postponed changes at the same time as the unavoidable disruption of activities due to automation.

B. Impacts on Personnel and Patients from Ancillary Area Systems and Hospital-Wide Systems

1. Physician Impacts

Computerization of one or more hospital areas may have a significant effect on the physician and his approach to patient management and decisionmaking. The following are some of the more common ADP impacts on physicians:

- Changes in the method, frequency, and time spent writing orders and obtaining test results. Simpler and faster ordering and retrieval of test results is a benefit of automation that is often reported by physicians (see, for example, Ref. 1, page 73). Reduced turnaround times for test results should reduce the physicians' need to make telephone inquiries for these results, with the potential changes in these activities being greater for systems with terminals located on the hospital wards, such as HIS.

- Change in ability to follow trends in patient data and to monitor a patient's condition. Cumulative reports provided by hospital ADP systems consist of chronological summary statistics on patient test results that should enable the physician to follow trends in patient data more closely. If the ADP system maintains patient care data from various treatment facilities in a single, regional data base, the system's potential contribution is even greater. An

impact specific to hospital-wide ADP systems is that it allows the physician to review the overall status of his patients via HIS terminals and therefore improves his ability to monitor a patient's condition.

- Problems with continued staff orientation to manual information-retrieval procedures. In hospitals where automation is limited to specific areas and physicians are assigned to these areas on a rotating basis, the problem exists of continually having to orient the physician in the correct use of the ADP system if considerable time has passed since his last assignment to the automated department(s).

- Changes in the quality and intensity of peer review. The capability exists with most hospital ADP systems for more accurate peer review of physician performance through improved documentation of drug therapy and actions taken by the physician as a result of diagnostic studies or computer indications of patient abnormalities.

- Change in the proficiency of information handling and retrieval. Hospital-wide ADP systems require health care providers to learn new methods of information handling (i.e., using ADP terminals), and the proficiency of some physicians in these activities may decrease compared not only to other physicians but also to nurses. This occurrence may lead to a partial reversal in the role status of physicians relative to nurses, a change with which many physicians at El Camino Hospital were not comfortable (Ref. 4, page 128).

- Change in awareness of daily schedules, hospital activities, and available resources. In addition to processing and transmitting specific patient data, hospital-wide ADP systems can provide the physician with his daily schedule of appointments and rounds, notification of meetings or administrative announcements, and information concerning the availability of beds, medications, and other hospital resources.

2. Nurse Impacts

The implementation of an ADP system, particularly a hospital-wide system, can be expected to affect nurses as well as physicians. Examples of some of the more significant impacts in this area are:

- Reduction in time spent performing administrative and clerical procedures. Automatic data processing can increase the nurses' capability to perform their functions more effectively by reducing the time spent on such administrative and clerical procedures as transcribing orders, generating work schedules and summaries, and posting reports in patient charts. The additional time made available by automation may be spent conferring with physicians and other staff members about patient management and performing "bedside" nursing care procedures. However, as discussed in Section IVA, effective management may be required in order to channel this additional time into productive activities.
- Changes in method and frequency of transcribing orders and obtaining test results. If the system includes cathode ray terminals (CRTs) at nursing stations, then these will allow for the direct entry

of physician orders into the patient's chart. These orders will be automatically transmitted to the appropriate ancillary departments, thus eliminating the need to transcribe them to nursing documents and request slips. Test results can be displayed on the CRT screen, reducing the number of telephone calls made by the nurses to ancillary departments to obtain results.

- Problems with continued staff orientation to manual information-retrieval procedures. If only one area of the hospital is computerized and the nurses rotate assignments to areas, then the additional problem exists, as with physicians, of continually having to instruct nurses as to the correct use of the automated system.

- Change in continuity of care delivered. Hodge states that an automated system "eliminates many of the distractions inherent in manual information-handling, distractions that make it difficult for nurses to function efficiently—the constant cross-checking of files, the countless phone calls to trace misplaced orders, locate late test results, and so on" (Ref. 4, page 145). Automation may also improve continuity of care by improving the quantity and quality of information that is passed on at each change of nursing shifts. If, however, the reliability of the ADP system and equipment is low, then the continuity of care delivered by nurses may deteriorate until efficient system operations are restored.

- Change in role status relative to the physician. Because nurses interact with the ADP system more frequently than physicians they may have a better knowledge of the system's capabilities and be able to perform computer procedures more efficiently. Thus, physicians may have to rely more heavily on nurses for information entry and retrieval than was the case under a manual system.

3. Administrator Impacts

ADP systems, both in ancillary areas and hospital-wide, will provide more information to administrators than the manual system provides and should provide the information faster with less clerical effort. Some examples of impacts that may occur as a result are:

- Change in ability to schedule staff and patients. Computers can provide the hospital administrator with current staff directories that reflect the number of health care practitioners on board, their medical specialties, and their availability to the command (leave, TDY, etc.). This will allow administrators to schedule patient workloads accordingly, thereby reducing both physician and patient waiting time. However, problems can arise when the system is down since patient appointment schedules cannot be generated, and unless an adequate manual backup system has been initiated, the number of patients arriving for appointments at any given time will be unknown.
- Change in the amount of staff supervision. Automated information systems can reduce the number of clerical and administrative procedures performed by supervisors, allowing more time to be spent in direct supervision

of the staff. Supervision may also improve because routine procedures, such as filling prescriptions, become both more involved and more interesting to the officers in charge, as observed in interviews with pharmacy technicians at Charleston Naval Regional Medical Center (Ref. 3, page 20).

- Change in the ease of materiels management and inventory control. Automated systems have the capability to keep a perpetual inventory of all equipment and supplies; therefore, less frequent physical inventory checks may be required. ADP may also generate order requests, flag items that are running low, and identify special handling requirements for certain medications and biological products.

- Change in ease of producing end-of-month workload summaries and of predicting future workloads. Computers can be programmed to generate end-of-month workload studies in the format designated by the user. This capability eliminates the need to keep a continual tally of workload statistics manually and reduces the possibility of lost data. Online inquiry capability allows the administrator to obtain workload statistics in a timely manner from a central data base to aid in predicting future workloads.

- Change in top management involvement. Smith states that "a computer-based HIS should strengthen the hospital administrator's role; however, the more complete information available to him might tempt the administrator to overcentralize authority for hospital operations in his office" (Ref. 9, page 64). The computer should provide middle management with more data to make decisions, thus reducing the need for top management to become involved in departmental decisions.

- Shift in management focus to more long-range planning. Smith also maintains that "in a total hospital information system, the improved information capability and resulting decisionmaking ability of department heads will make available a standard of managerial excellence not possible under manual conditions" (Ref. 9, page 64). The increased managerial competence of department heads should allow the administrator to delegate more easily the authority and responsibility for making decisions that affect the internal, day-to-day operations of the facility. This should enable the administrator to focus his attention on long-range planning for computer-predicted trends in workload, staffing, and budget so that the facility may fulfill its proper role in the total health care system.

4. Technician and Clerk Impacts

The implementation of an automated information system will produce significant impacts on technicians and clerical employees. Examples of these impacts are:

- Change in task flexibility. Computers provide a more rigid structure for performing tasks. Technicians/clerks must follow standard procedural guidelines in order to process information. Shortcut methods and simplified procedures are not permitted by the system and cannot be initiated unless programming changes are made. The relative inflexibility of an automated system can frustrate individuals, especially when the task involved appears to have no demonstrable value (e.g., sophisticated "log on" procedures to enter routine laboratory results).

- Change in involvement in patient care process. Technicians and clerks are usually the primary users of the ADP terminals. Pharmacy technicians interviewed at Charleston Naval Regional Medical Center reported that they had definitely become more effective and involved in the patient care process as a result of the drug interaction detection and patient compliance-monitoring capabilities of the pharmacy computer (Ref. 3, page 22). With a hospital-wide system, technicians and clerks are likely to become more involved with interdepartmental (rather than only intradepartmental) communication, and this exposure to terminal functions and procedures may increase their awareness of hospital-wide procedures and resources.

- Change in amount and type of clerical work performed. Computer systems can copy, summarize, sort, and file information. They can also prepare work documents and supply requisitions and print final reports. Therefore, the amount of time that individuals spend performing these tasks should be significantly reduced. However, additional clerical procedures required by an automated system may serve to increase the time individuals spend performing clerical tasks. A comparison study between an Automated Multiphasic Health Testing (AMHT) system and a Multiphasic Health Testing (MHT) system of personnel time required to perform clerical tasks associated with scheduling, registering, and processing physical examination patients revealed that the total clerical time expended per patient was slightly greater with the automated system (Ref. 5, page 17). However, the automated system was operating at only 50 percent of

the capacity for which it was designed, performed more clerical procedures, and obtained more detailed information than did the manual system.

- Changes in the ability to detect and correct mistakes. Automated information systems are programmed with built-in safeguards to detect errors in the information being input and processed and to identify these errors so that prompt corrective actions may be taken. Pharmacy technicians at one ADP implementation site felt that this was one of the most positive features of automation (Ref. 3, page 19).

- Changes in the knowledge of abnormal values and correct procedures. Hodge states that "An information system is a great aid to learning because it can present precisely the material a doctor or other health care provider needs at the exact time that he or she must make a decision based on that material" (Ref. 4, page 58). The computer can serve as an easily accessible centralized reference guide for both abnormal values (values outside a predetermined acceptable range) and correct procedures (e.g., proper methods and routes of drug administration).

5. Patient Impacts

While patients are affected in some way by nearly all hospital ADP systems, the impacts are typically indirect and more limited in scope than those for hospital personnel. Primary examples of impacts on patients are:

- Change in the quality of care received. The most important benefit that patients can derive from an automated information system is improved quality of care. If the system notifies hospital staff of

abnormalities in test results, inventory levels, drug combinations, or even diet combinations, then potential patient complications may be avoided. By performing routine clerical tasks, the computer should increase the availability of professional staff for direct patient care.

- Change in patient waiting times. One of the goals of all types of hospital ADP systems is to speed service to the patient through improved scheduling methods and more rapid information processing. It is not unusual however for even highly reliable systems to fail to reduce patient waiting time, or even increase it, since the computer may perform many more procedures (such as scanning the patient's drug history) before completing the patient transaction. Also, the amount of patient data required as input by or printed out by the system as well as the numbers and types of terminals, printers, or personnel may be inappropriate for optimal system performance (see Chapter IV).

- Change in patient satisfaction. While patient satisfaction with ancillary area service is directly related to patient waiting time for the service, satisfaction does not appear to be as highly associated with the quality of care received. An ADP system that refuses to accept a normal meal selection for a patient on a restricted diet, or to process a prescription refill that is presented 3 weeks earlier than it should be, is unlikely to be viewed favorably by the patient at the time of his visit (see, for example, Ref. 3, page 11).

C. Impacts from Other Hospital Systems

1. Administrative Management Information Systems

Administrative management information systems (i.e., transactional systems) usually have a limited impact on the hospital's medical staff, especially in a military medical treatment facility where itemized billing is minimal. However, some transactional systems, such as a patient administration system, could directly affect the hospital medical staff. Patient administration systems could improve administrative reporting procedures and overall patient administration through more efficient information handling. Examples of patient administration procedures that may be affected by automation are:

- Registration
- Pre-admission
- Admission
- Changes in administrative status
- Patient accountability
- Third-party liability
- Report generation.

2. Food Service Management Information Systems

Food service management information systems are considered to be ancillary hospital information systems, since they also make an important contribution to the quality of care. However, unlike most other ancillary systems, food service systems impact less directly the activities of physicians and nurses. Some aspects of food service operations most likely to be affected by an ADP system are:

- Inventory control
- Ease of generating and revising diet orders
- Methods of food cost accounting
- Menu preparation and planning
- Timeliness and accuracy of recipe calculations
- Number of nutritional analyses performed
- Operational scheduling of personnel, food production, and equipment
- Labor productivity of food service personnel
- Ability to forecast equipment and space requirements
- Job satisfaction of dietitians and dietetic technicians.

3. *Hospital Logistics Information Systems*

Automated hospital logistics systems are designed to improve the process of intra-hospital delivery of supplies, typically through effective utilization of a cart exchange process and an automatic cart transport system, operations of which are ADP-supported. Logistics technicians and other supply personnel are the primary users of the computer hardware and software, while the professional medical staff may also be considered beneficiaries of the system. Some aspects of logistics operations most likely to be affected by computerization are:

- Inventory control
- Ease of generating and revising cart schedules
- Number, accuracy, and legibility of reports and lists

- Ability to forecast supply requirements
- Labor productivity of logistics personnel
- Job satisfaction of logistics personnel.

The general impacts encountered with the installation of these other information systems should be similar to the general impacts discussed in Section IIA. The problems and strategies relating to system implementation that are discussed in Chapters III and IV apply to these other hospital systems as well.

REFERENCES

1. Allen, D., Corn, R., Hodgdon, J., and Brooks, R., Evaluation of the Tri-Service Laboratory Information System (TRILAB I) at Malcolm Grow USAF Medical Center, HSDN 77-7, Analytic Services Inc., December 1977.

2. Barnett, G. O. and Zielstorff, R. N., "Data Systems Can Enhance or Hinder Medical, Nursing Activities." Hospitals, Vol. 51, October 16, 1977.

3. Hodgdon, J., Interview Evaluation of the DataStat Outpatient Pharmacy System at Naval Regional Medical Center Charleston, HSDN 78-2, Analytic Services Inc., July 1978.

4. Hodge, M. H., Medical Information Systems: A Resource for Hospitals, Aspen Systems Corp., 1977.

5. Mackintosh, D., et al., Interim Evaluation Report for the Automated Multiphasic Health Testing System (AMHTS) at National Naval Medical Center, HSDN 78-1, Analytic Services Inc., May 1978.

6. Munson, F. C. and Hancock, W. M., "Problems of Implementing Changes in Two Hospital Settings," AIIE Transactions, Vol. 4, December 1972, pp. 258-266.

7. Sanders, D. H., Computers in Society, New York: McGraw-Hill, 1977. Second edition.

8. Schmitz, H. H., Ellerbrake, R. P., and Williams, T. M., "Study Evaluates Effects of New Communication System," Hospitals, Vol. 50, November 1, 1976.

9. Smith, J. L., "The Computer—Its Impact on the Physician, the Nurse, and the Administrator," Hospitals, Vol. 43, September 16, 1969.

10. Tolbert, S. H. and Pertuz, A. E., "Study Shows How Computerization Affects Nursing Activities in ICU," Hospitals, Vol. 51, Sept. 1, 1977.

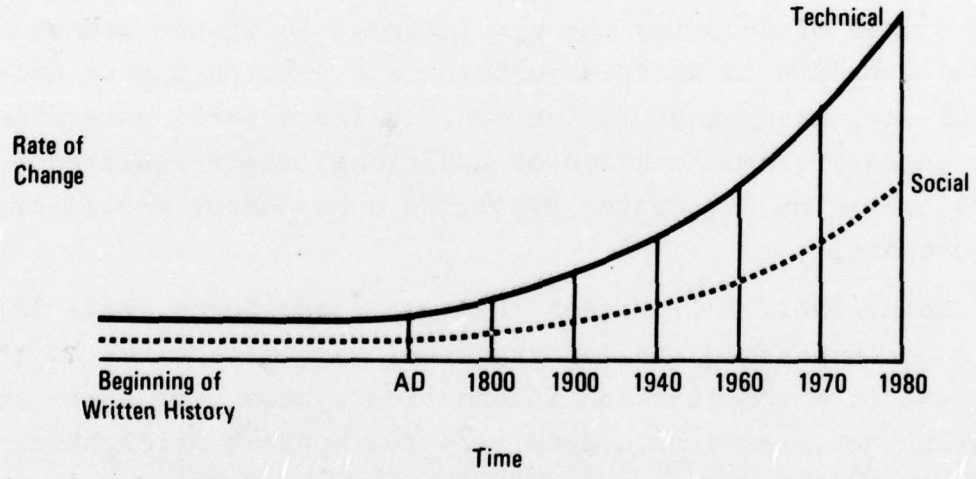
11. Whisler, T. L., Information Technology and Organizational Change, Belmont, Calif.: Wadsworth Publishing, 1970.

III. RESISTANCE TO CHANGE AND RELATED STRATEGIES FOR SUCCESSFUL SYSTEM IMPLEMENTATION

A. Introduction

A dominant theme in the current literature on social change is that the rate of change is accelerating over time, and social change is lagging behind technological change. Figure 3 illustrates this concept.

FIGURE 3
RATES OF TECHNICAL AND SOCIAL CHANGE*



The term *cultural lag* was first used by Ogburn (Ref. 12, Chapter 8, page 21)to describe the persistence of social norms in response to technological change, and this macro-theory has since been applied at the micro-level to explain instances of resistance to change encountered in the factory, hospital, classroom, etc. While it may be true that some delay is inevitable between the time an innovation, such as

---

* Ref. 12, Chapter 10, page 2. Originally appeared in Watson, Social Psychology: Issues and Insights, 1966, page 533.

an ADP system, is introduced and the time it is accepted by most of the affected individuals, cultural lag by itself cannot account for the wide variation in the length of time required for system acceptance that has been reported in past evaluations of hospital computer systems. Cultural lag will be treated in this report as a subset of resistance to change. If user *acceptance* of the ADP system is defined as the extent to which the users either approve of or endure the new system without protest, then user *resistance* to the ADP system is defined as the converse of acceptance, or the extent to which the user opposes the new system in one or more of the ways described in this chapter. While management action taken during the course of adopting the new information system cannot avoid a period of staff adjustment and concern due to cultural lag, management action can, in large part, determine the intensity and duration of additional staff resistance that cannot be attributed simply to a necessary period of adjustment.

Kenny (Ref. 17), Munson (Ref. 21), and Lucas (Ref. 18) strongly emphasize the importance of user acceptance to the success of a computerized information system, and Ainsworth states that "there have been very few systems which have been installed without significant user resistance on some level" (Ref. 1, page 48). Examples of hospital ADP systems that have encountered significant user resistance are the hospital-wide systems at El Camino Hospital in California (Ref. 10) and at Maine Medical Center (Ref. 11), the Missouri Automated Radiology System (MARS) in St. Louis (Ref. 9), the London Hospital Computer Project (Ref. 17), the Air Force Clinical Laboratory Automated System (AFCLAS) at Wright-Patterson AFB in Ohio (Ref. 6), and the Automated Multiphasic Health Testing (AMHT) System at the National Naval Medical Center in Bethesda, MD (Ref. 20). While user resistance to

the ADP system is not the only problem that may be encountered during the pre-implementation and implementation periods, we emphasize it strongly in this report because: 1) it is an important indicator and consequence of most other problems of implementation; and 2) it is one of the only factors that could undermine the entire system at such an early stage (i.e., first year) of its existence.

B. Forms of Resistance

User resistance to the ADP system may appear in a variety of forms. Some typical forms of resistance are listed below roughly from the least active to most active forms, many of which have been cited by Sanders (Ref. 22, page 235) and Zaltman et al. (Ref. 26, page 85):

- Showing lowered morale
- Complaining about the system
- Avoiding proficiency with new equipment or procedures
- Bypassing ADP system/keeping own manual records
- Withholding data and information
- Lack of cooperation with managers or system personnel
- Slowing performance
- Absenteeism or tardiness
- Lobbying against the system
- Mistreatment of hardware
- Mistreatment of software/providing inaccurate data
- Resignation or transfer.

Resistance may vary in both size (from an individual staff member to a large group) and intensity (from passive to active forms). The implications for the success of the system

become more critical as resistance increases along either or both scales. The particular form(s) with which an individual chooses to express his dissatisfaction with the system may depend in part upon his reasons for resisting the system, which is the subject of the next section.

C. Reasons for Resistance

The numerous motivating forces that may stimulate one or more individuals to resist a new system may be separated into 1) reasons for resisting during the pre-implementation period, and 2) reasons for resisting during the implementation period. (User resistance is usually not a factor during the post-implementation period.)

1. Pre-Implementation Period

Prior to the installation of an ADP system, staff members may resist the change for any of the following reasons:

- High satisfaction with the status quo. Hoffman (Ref. 16, page 46) and Zaltman et al. (Ref. 26, page 97) cite the lack of a need for change as an important reason for resisting the new system. Since the transition to computerization requires a temporary loss of equilibrium and learning of new procedures, the staff must perceive the new system to be not just equal to but superior to the old system.
- General perceptions of computer systems. Many people have preconceived notions of automation that often consist of a basic mistrust of computers. An individual's low expectations may also be based on some unfavorable prior experience with a similar system or with computers in general.

- Uncertainty as to how the individual and the organization will be affected by the new system. Fear of the unknown is a major force underlying resistance to change (Ref. 12, Chapter 4, page 12), primarily because the individual is likely to channel this fear into misconceptions and false expectations regarding the system. This is a particularly important factor if the innovation has not been introduced elsewhere or has failed elsewhere, since staff fears cannot be allayed by evidence from or visits to other sites using the new system.

- Threat to vested economic interests and job security. Sanders states that "some physicians may find it difficult to accept the use of computers in medicine because of the conviction that the machines may reduce their intellectual contributions to health care and help paramedical personnel usurp their duties" (Ref. 22, page 235). Since computers have a reputation for replacing people, this is a common reason for resistance among clerical personnel in particular.

- Threat to status and/or independence. The changes in organizational structure and in the information-handling proficiency of individuals that often accompany the adoption of a new information system may threaten to reduce the status of employees at any level of the organization. Also, staff members (including physicians) may view an ADP system as a threat to their independence to the extent that their performance is now documented in the computer and subject to supervisory or peer review.

- Reduction in social satisfaction. If the individual expects the new system to damage interpersonal relations as a result of reorganization or of differential access to or impacts of the ADP system on the staff, then he is likely to resist the system to avoid reductions in his social-need aspects of job satisfaction (Ref. 22, page 236).

- Unacceptable concomitants. There are many structural factors in organizations that are sources of resistance. The principle of *systemic coherence* holds that "it is difficult to change one part of the system without changing other parts of the system" (Ref. 26, page 88). Consequently, the computer is likely to bring with it changes in operation that are due more to reorganization than to computerization (as described in Chapter II), and it may be these concomitant changes in supervision or work environment that are the true causes of staff resistance to the ADP system.

- Perceptions of the purpose of the new system and the degree to which adoption of it is voluntary. Bennett states that, with the exception of transactional systems, "it is essential that motivation for a computer project be clearly seen as a sincere desire to improve the care and treatment of the individual patient and not primarily to reduce costs or produce better statistics" (Ref. 5, page 135). Another major determinant of user acceptance is the extent to which the user feels that his prior approval of the system has been sought and obtained and/or that he has the option of doing things the old way if he prefers (Refs. 1,7,8,16,22, and 26). This is a problem with hospital ADP systems since in most cases the computer is thrust upon the users with very few aspects of the new system being voluntary.

- The system appears to be inferior or inappropriate. As discussed in Chapter II, the short-term impacts of automation tend to be negative, entailing a significant amount of staff effort and disruption of operations, so it is often difficult for the personnel to view this effort as being outweighed by the middle-range and long-range expected benefits. The system may also appear to the staff as too complex for their purposes, or they may perceive of the implementation schedule as involving too much, too soon, and too fast.

Zaltman et al. point out that pre-implementation resistance can be beneficial, saying that its existence "may highlight problems in the organization and bring forth or require more detailed and careful reasoning by the proponents of the innovation. Indirectly, the threat of resistance causes the advocates of change to plan ahead and anticipate possible negative consequences of the innovation" (Ref. 26, page 102).

2. Implementation Period

After the installation of the ADP system, resistance to the system may exist for any of the following reasons:

- Unrealized positive expectations and/or realized negative expectations. Hoffman states that "perhaps no other single factor has had a more detrimental effect on automation and its acceptability than the *panacea syndrome* [resulting from] zealous overselling by computer manufacturers who grossly underestimated the complexity of the hospital field" (Ref. 16, pages 45-46). In order to avoid pre-implementation resistance, hospital administrators may likewise overstate system objectives, not realizing that doing so only compounds the problem of post-installation resistance.

Even realistic positive expectations may be questioned during the troublesome implementation period, and to the extent that changes occurring during implementation lend support to the employee's initial fear of reduction in job security, social satisfaction, independence, or status, his resistance will increase.

- System performance is or appears to be inferior to the old system. The first month of system operation is a critical time when the actions, interactions, and opinions of managers, programmers, and users lay the framework for the ultimate success or failure of the system. Haessler and Cooper (Ref. 11) stress the importance of early system performance to system acceptance in their study of the arduous implementation of the Maine Medical Center MIS. Lucas also tests and confirms the hypothesis that "systems with higher technical quality result in more favorable user attitudes and perceptions of information systems, and the information services staff" (Ref. 18, page 22). The dual methods of recording and filing data that must be performed until system reliability is assured and the additional data required by the computer for registering and processing patients, both contribute to the impression that more work is involved with the new system than with the old. System efficiency cannot reach a high level until user proficiency is attained, and even after these obstacles are overcome, it may well be that the performance of the new system actually is inferior to that of the old, unless major modifications are made.

- Strained relations. Among the users, strained relations during the systems implementation period may not only serve to increase resistance to the computer, but also may in turn be caused by the resistance itself. Describing the experience at the Maine Medical Center, Haessler and Cooper write that "anti-computer factions arose and longstanding disagreements were aggravated" (Ref. 11, page 625). If some staff members are given more privileged access to the system than others, or if some staff benefit substantially more from automation than others, then strained relations are even more likely to occur (Ref. 14, page 20). Temporarily reduced efficiency of ancillary services also requires the patience and understanding of other hospital staff and of patients. The users are often made scapegoats for these system inefficiencies.

- The system serves as a scapegoat for unrelated problems or inefficiencies. Several studies have observed that reduced efficiency of operations due to factors other than the computer is often mistakenly attributed to the ADP system (Refs. 4 and 14). In some instances, trends in staffing levels and workload may obscure the true performance of the new system as compared to the old, making it difficult for the users and managers to accurately assess the merits of the new system.

- The system is inconvenient, confusing, or disruptive. Upon installation of the automated system, the users must become familiar with new tasks and procedures while processing the normal patient workload at the same time. In addition, these new procedures continue to undergo modification during the first few

months the system is operational; other automated functions may become operational; and new staff (and for some systems, patients) must become oriented to automated procedures. Gall cautions that at El Camino Hospital this "climate of continual change created by introducing a large number of changes over the implementation period constituted a constant source of frustration for users, subverted substantial labor to the task of communicating changes to users, and reduced operational efficiency and increased errors" (Ref. 10, page 123).

- Communication, feedback, and response delays. Any user frustration that develops as a result of early problems with the new equipment or procedures will be further aggravated by delays in discovering and correcting these problems. Data processing personnel and health care professionals are often unable to effectively relate their needs to one another, and this communications problem can be a serious impediment to system success (Refs. 1 and 3).

- Conformity to peer pressure. Individual motivation to conform to peer pressure becomes an additional source of resistance when active group resistance exists, such as the anti-computer factions that were formed among physicians at El Camino Hospital (Ref. 10) and at Maine Medical Center (Ref. 11). Staff members who resist the ADP system primarily to conform to peer pressure will typically exhibit only passive forms of resistance, such as responding negatively on ADP attitude surveys and not communicating or cooperating to any great extent with data processing personnel.

As in the case of pre-implementation resistance to change, user resistance occurring during system implementation is not necessarily unhealthy from the managerial standpoint. The user is in the best position to quickly identify system problems and inefficiencies, and in many instances it is by attending to user complaints and protests that managers and ADP personnel are able to correct minor problems before they become major ones.

D. Strategies for Successful System Implementation

The management guidelines presented in this section for minimizing user resistance and achieving smooth and swift system stabilization have been drawn from: 1) general discussions of resistance to innovation or change (Refs. 8, 12, and 26); 2) specific discussions of resistance to ADP systems (Refs. 1-5,7,16,18,19,22,24, and 25); and 3) lessons learned from previous installations of ADP systems in civilian and military hospitals (Refs. 6,9-11,13-15,17,20,21, and 23).

1. Pre-Implementation Period

Prior to the installation of the ADP system, the following strategies are suggested to prepare for the transfer to computerized operations:

- User involvement. Within all three types of background literature, the most often cited key ingredient to system success is user participation in the planning and decisionmaking process with regard to output format, terminal and printer type/location/number, procedural changes, timing and method of transfer to ADP operations, training and education of staff, etc. (Refs. 1,4,7,8,10,11,16,18, and 24). In Hoffman's words, "neglecting this elementary principle will result in problems too numerous to relate" (Ref. 16,

page 47). Too often system planners "expect the user to describe all his functions, but they do not seem to appreciate the value or need to return the favor" (Ref. 1, page 48). Although total user involvement is impractical where large numbers of staff are involved, system planners should seek to obtain the participation and cooperation of informal group leaders (i.e., opinion leaders) as well as of supervisory personnel. The implementation process can often be greatly facilitated by placing a high degree of system-related responsibility in the hands of one or two willing and capable on-site users. Sanders cautions that "participation is not a gimmick with which to manipulate people. Employees asked to participate must be respected and treated with dignity, and their suggestions must be carefully considered" (Ref. 22, page 238). Guidelines for planning and conducting meetings between the users and project managers are outlined by Burch and Strater (Ref. 7, page 381). While military health care system managers are typically more constrained in their ability to allow major user inputs into the decisionmaking process, user involvement is equally important in the military environment, and there is considerable room for improvement in the amount of management effort directed toward this end.*

- Communication and education. Based on experience gained in implementing the Technicon Medical Information System in six U.S. hospitals, Virts concludes

---

* See Ref. 7, page 380, for further discussion of the hazards of using the *bulldozer approach* to system implementation.

that "the environment of acceptance increased in proportion to the quality, consistency, and honesty of communication about the system" (Ref. 24, page 996). The importance of producing realistic (i.e., neither too high nor too low) staff expectations is also stressed in numerous other studies (Refs. 5,6,11,23, and 26). Communication may best be improved through status reports at routine meetings, special meetings used to develop ADP policy recommendations, hospital newsletters, and ADP newsletters published regularly or at implementation milestones to keep users informed. It is the responsibility of hospital managers to monitor the attempt to improve the quality of communications between the users and data processing personnel. In addition to educating those employees who will be using the system input equipment or output reports on a daily basis, some public relations effort should be directed to patients and other hospital employees who may be impacted by the system.

- Management and user visits to sites with a similar ADP system. No amount of classroom-type education can do as much to reduce staff fears and uncertainty regarding the new system as visits to another hospital that has successfully implemented a similar system. Informal question and answer sessions with experienced users at another hospital whose opinions of the system are more credible than those of ADP personnel can also alleviate staff apprehension. In a 1968 survey of 543 hospitals using computers, 46 percent of the administrators responding reported that such visits were their most effective sources of information in planning for automation, followed by attendance at ADP meetings or symposia (reported by 35 percent of the respondents) (Ref. 13, page 27).

- Training of both users and on-site ADP staff. While user training is rarely overlooked prior to most ADP installations, the amount of training is often inadequate. Wooldridge and London point out that "many sites spend much time and effort explaining to the lower level staff how the new input forms are to be completed, but fail to explain the outputs as well" (Ref. 25, page 129). Managers must decide who will do the training, when it will be done, and how much staff time will be required. If the users are to view the system as "ours" rather than "theirs," it is important that they be involved in vendor-conducted training at an early stage, a view supported by the experiences of Scholes (Ref. 23, page 639) and Virts (Ref. 24, page 997). Virts also argues that "training should take place immediately before it is applied in the real world situation and should be directly relevant to the tasks to be performed." Referring to the experience at El Camino Hospital, Gaul adds that "the delay between training and initiation of actual operation by users had an obviously detrimental effect upon user effectiveness" (Ref. 10, page 123). Training should require as little staff overtime as possible, since the implementation process itself will require much in the way of extra staff effort and patience. Finally, the on-site ADP staff must be oriented to the methods and needs of the users, and this additional training requirement should not be overlooked (Refs. 1 and 3).

- Conversion, backup, and debugging preparations. As described by Wooldridge and London (Ref. 25, page 125), there are four primary methods of implementing

a new system. The *parallel method* refers to operating the new system side by side with the old one for several cycles, typically for 2 to 4 months. The *pilot method* involves putting the system in, in its entirety, but only in one part of the hospital. Bringing the system up in phases (i.e., by functions) is known as the *gradual method*. Finally, the *immediate method* refers to stopping the old system one evening and beginning the new one the next morning. (See Burch and Strater, Ref. 7, page 351 for further illustration of these four approaches.) While each method has its particular advantages, depending upon the type of system, the immediate method carries both the greatest risk if not carefully executed and the greatest rewards if properly implemented. The other three methods involve transition time, the length of which has been shown to be critical to the success of the system. Regardless of the method selected, system reliability is almost always a problem during the first month of ADP operation, so it is very important to prepare a good backup system to avoid user protests (Refs. 17 and 25).

- Timing the change. Ainsworth states that "perhaps the most important area in the generating and sustaining of user interest lies in the scheduling of the project. This schedule of development is usually presented to the user by the ADP group and is based upon their ability to develop the new system. This basing of schedules and commitments on the resources of the ADP group is perhaps the single greatest mistake made today. The ADP department can develop and implement a system in far less time than the user can adjust

to the system" (Ref. 1, page 51). Ainsworth's view (that the user should always be consulted as to the timing of the ADP installation) is supported by Sanders (Ref. 22, page 238) and the experience at Charleston Naval Regional Medical Center where a pharmacy system was installed at the beginning of the busy winter months, creating both user and patient initial dissatisfaction with the system (Ref. 14, page 18). Whenever possible, the new system should be installed during a period of relatively low seasonal workload to minimize the disruption created by temporary system inefficiencies.

2. Implementation Period

After the system has been installed, the following strategies are suggested to minimize problems occurring during the implementation period:

- Controlling the change. As we have stressed in this chapter, managers should seek to optimize the length of the transition period. Too rapid a transition will create significant resistance unless the users have been well prepared for the new procedures. Too slow a transition leads to significant user resistance by prolonging the duplication of effort required for dual recording methods (manual and automated together) and by creating a climate of continual change. Experience has also shown that it is important to maintain the same or greater staffing level during the implementation period as before automation (Ref. 14, page 24) and, wherever possible, to allow, but not require, individuals to use the old methods of information handling until they are ready to adopt the new procedures (Ref. 11, page 632). This latter option

may be especially important for physicians and serves as a useful indicator of system acceptance; namely, the proportion of the staff who prefer to record and obtain information through the ADP system at a given point in time. High staff turnover during the implementation period may aggravate the problem of system efficiency and should be minimized by military managers to the extent possible (Ref. 17, page 139 and Ref. 23, page 646).

- Use of an in-service system implementation team. Several members of the pharmacy staff at Charleston Naval Regional Medical Center expressed the opinion that many of the concerns and problems generated during the difficult first month of system operation could have been reduced by an implementation team (preferably in-service) consisting of a public relations specialist, an ADP troubleshooter experienced with the system equipment, and a pharmacist experienced with the system procedures and output (Ref. 14, page 18). The use of such a team and the importance of not disassembling the team and withdrawing ADP troubleshooters too soon has also been supported by the experiences of personnel associated with numerous ADP projects in civilian hospitals (Refs. 11, 15, and 17).

- User and ADP staff communication and guidance. As we mentioned earlier, effective communications between users and ADP personnel is especially important during the implementation period. Lucas suggests designating user representatives to interface with the data processing department and emphasizes, based upon his study of many ADP

projects, that "for any given system, no matter what the problem, the user should be able to contact a single representative of the information services department who is responsible for seeing that the problem is solved" (Ref. 18, page 111). It is also the responsibility of the users to assist the ADP staff when needed so that they can fully understand and correct any problems that may arise.

- On-going user training. The evaluation of the hospital-wide system at El Camino Hospital showed that the attitudes of the staff toward the computer improved as their perceived self-proficiency with the system improved (Ref. 15, page 136). This relationship, together with the likely addition of new personnel during the implementation period, point to the importance of a good on-going training program. Managers should also be careful to recognize when problems in the training of users may be due to system over-design. As Wooldridge and London put it, "if it proves very difficult to train people in the new system, then this may not just be due to a reaction against the system. Perhaps the system is just too complex for them to operate; the forms are too complex; the outputs difficult to interpret and produced at the wrong time" (Ref. 25, page 139).
- Fireman maintenance. Problems with the new system must be expected during its early stages of operation, and it is not so much these problems that lead to major user resistance as it is the delays in getting such problems rectified. Wooldridge and London (Ref. 25, page 133) use the term *fireman maintenance* to describe the type of rapid debugging and troubleshooting that is required to prevent major drops in system efficiency

and user acceptance. This strategy is also advocated by Lucas (Ref. 18, page 111) and Hoffman (Ref. 16, page 47).

Few hospital computer systems have been installed without having to endure a tumultuous and tedious period of transition to automation. But by understanding the nature of user resistance to change and following the guidelines suggested in this chapter, military health care system managers should be able to minimize the length of time required to reach a high level of user acceptance and system efficiency as well as to minimize the frequency and urgency of problems occurring within this time period. Chapter IV discusses further steps that can be taken to realize benefits after the implementation period is over.

REFERENCES

1. Ainsworth, W., "The Primacy of the User," Infosystems, April 1977, pp. 46-48, and May 1977, pp. 50-54.

2. Anderson, J., "Education of Health Staff in Information Processing Techniques," Medinfo 1977, pp. 975-978.

3. Ball, M. J. and O'Desky, R. I., "Ten Rules to Bridge the Communications Gap Between the Health Care Professional and his Computer Systems Department," Hospital Topics, September 1976, pp. 53-55.

4. Barnett, G. O. and Zielstorff, R. N., "Data Systems Can Enhance or Hinder Medical, Nursing Activities," Hospitals, Vol. 51, October 16, 1977, pp. 157-161.

5. Bennett, W. L., "The Computer and the Clinician," Medinfo 1974, pp. 133-136.

6. Brooks, R. C., Blackmon, P. W. Jr., and Casey, I. J., Evaluation of the Air Force Clinical Laboratory Automated System (AFCLAS) at Wright-Patterson USAF Medical Center, Analytic Services Inc., HSDN 77-5, May 1977.

7. Burch, J. G. and Strater, F. R., Information Systems: Theory and Practice, New York: John Wiley and Sons, 1974.

8. Coch, L. and French, J. R. P., "Overcoming Resistance to Change," Human Relations, Volume 11, 1948, pp. 512-532.

9. Dickhaus, E. A. and Fairman, W. L., "Technology Evaluation, A Case Study of MARS," Medical Care, Vol. 15, No. 1, January 1977, pp. 79-92.

10. Gall, J. E., Jr., "Introduction of a User-Oriented Total Hospital Information System into a Community Hospital Setting—Tactical Management Revelations," Medinfo 1974, pp. 121-126.

11. Haessler, H. A. and Cooper, C. G., "Staff Reaction to a Hospital Information System," MedComp 1977, pp. 625-637.

12. Havelock, R. G., Planning for Innovation, Ann Arbor: The University of Michigan Press, 1976.

13. Herner and Company, The Use of Computers in Hospitals, National Center for Health Services Research and Development, NTIS No. PB195629, November 1970.

REFERENCES (Cont.)

14. Hodgdon, J. D., Interview Evaluation of the DataStat Outpatient Pharmacy System at Naval Regional Medical Center Charleston, Analytic Services Inc., HSDN 78-2, July 1978.

15. Hodge, M. H., Medical Information Systems: A Resource for Hospitals, Aspen Systems Corp., 1977.

16. Hoffman, P. B., "Meeting Resistance to Automation," Hospital Progress, April 1971, pp. 45-47.

17. Kenny, D. J., "Management Tactics for the Introduction of Computers into Health Care Units," Medinfo 1974, North Holland Publishing Company, pp. 127-131.

18. Lucas, H. C., Why Information Systems Fail, New York: Columbia University Press, 1975.

19. Mencotti, J., "Making Change Less Jarring," Hospital Financial Management, June 1978, pp. 40-43.

20. Mackintosh, D. R., Hertz, R., St. Clair, D., Brower, L., and Carlisle, R., Interim Evaluation Report for the Automated Multiphasic Health Testing System (AMHTS) at National Naval Medical Center, Analytic Services Inc., HSDN 78-1, May 1978.

21. Munson, F. C. and Hancock, W. M., "Problems of Implementation Change in two Hospital Settings, AIIE Transactions, Vol. 1, No. 4., December 1972, pp. 258-266.

22. Sanders, D. H., Computers in Society, New York: McGraw-Hill, 1977. Second Edition.

23. Scholes, M., Forster, K., and Gregg, T., "Continuing Education of Health Service Staff in Computing," MedComp 1977, pp. 639-648.

24. Virts, S. S., "Introducing the Hospital-Wide Information System to Hospital and Medical Staffs," Medinfo 1977, North Holland Publishing Company, pp. 993-997.

25. Wooldridge, S. and London, K., The Computer Survival Handbook, Boston: Gambit Inc., 1973.

26. Zaltman, G., Duncan, R., and Holbek, J., Innovations and Organizations, New York: John Wiley and Sons, 1973.

IV. REALIZING SYSTEM POTENTIAL

Realization of benefits that are expected to result from the implementation of an automated hospital information system requires conscientious and careful planning and management at all levels and at each phase of the implementation process. While some system benefits occur almost automatically after installation, most can be attained only through successful planning, implementation, and modification of the system and its operating environment. This chapter assumes that system implementation has been successful and presents some important management strategies for identifying and exploiting areas of unused system potential after the first year of computerized operations. In addition, some of the strategies for realizing system potential that are presented in Section IVB should also prove helpful in minimizing many of the implementation problems that were presented in Section IIIC.

A. Sources of Potential

Hodge states that "medical information systems save work, but hospital managers save money. *Potential benefits* refer to saved work. If it is possible to translate the saved work into saved money, that is called a *realizable benefit*. If the necessary action has been taken, one has a *realized benefit*" (Ref. 5, page 170). However, some benefits of automation will probably accrue to the hospital without significant management action. Examples of these are general improvements in the timeliness, accuracy, legibility, and completeness of patient information (records, reports, rosters, etc.) as well as reductions in the kinds and numbers of forms.

In contrast to these automatic benefits, the following typical sources of system potential require specific management effort in order to realize savings:

- Elimination of unnecessary manual procedures. With any ADP system, some amount of manual recordkeeping is necessary as a backup system in the event of failure of the automated system. The extent to which savings may be realized in this area is proportional to the reliability of the ADP system and how often the backup manual procedures have to be implemented.

- Utilization of freed personnel time. While numerous hospital information system evaluations have demonstrated reductions in the time spent by health care providers in clerical work as a result of automation, few have reported increases in the time spent by the professional staff in direct patient care, and some, such as Tolbert and Pertuz (Ref. 6), have even recorded decreases.

- Utilization of freed space and/or equipment. Not all automated information systems save space and replace other equipment but if, for example, filing space is reduced and keypunch machines are eliminated, then additional savings may be realized, depending upon how the extra space and equipment are used.

- Utilization of freed schedules and the capacity for higher workload. If the ADP system results in reduced patient waiting and processing times, particularly for outpatient services, then management action may be required in order to reach a higher level of operating efficiency by readjusting the balance of staffing to workload.

- Utilization of system data by other secondary users. Other staff members and departments can often benefit from being given access to information stored in the

ADP system without violating the confidentiality of patient data. For example, pharmacists at the Charleston Naval Regional Medical Center noted that other areas of the hospital benefited from the up-to-date patient address and telephone information stored in the pharmacy computer (Ref. 4, page 9).

- Utilization of the planning, research, and educational capabilities of the system. Hospital computer systems can provide valuable assistance in charting and projecting not only overall workload trends but also trends in such things as food preferences, physician drug-prescribing routines, and specific patient diseases and injuries. Many systems also allow the user to enter hypothetical patient data in order to study rare cases in terms of adverse drug reactions and other abnormalities.

- Improvements in system performance by removal of shortcomings in hardware, software, or standard organizational and utilization procedures. Additional modifications to the hardware, software, or related hospital organizational and utilization procedures that should improve system performance can usually be identified after the first year of system operation. Too often this is the only source of system potential that does receive attention after stabilization of the ADP system.

- Improvements in system utilization through modifications to user staffing/skill levels, terminal type/location/number, input requirements, or output content/format. During the first year of system operation, hospital managers should carefully examine the new system in terms of: 1) the appropriate number and

location of terminals as well as the appropriate amount and format of computer input and output; and 2) the number and skill level of the users of the system. Managers should avoid looking only for short-term cost reductions. In some cases, an increase in staffing or in the number of terminals may ultimately result in the greatest realized savings.

A deliberate and organized effort on the part of the hospital management is required to identify and exploit these sources of system potential. Such an effort is the focus of the remainder of this chapter.

B. Post-Implementation Strategies for Realizing System Potential

After the ADP system has stabilized and user proficiency has reached a high level, the following activities have been shown to be effective in order to ensure that the benefits of the system are fully realized:

- Formation of a benefits realization team. If the task of benefits realization is not formalized, then hospital administrators may find it difficult to allocate time to this important activity. Hodge (Ref. 5, page 176) and Gaul (Ref. 3, page 125) recommend the use of a benefits realization team consisting of an administrator, a management engineer, and appropriate staff members to coordinate this process. Hospital management engineering is the specialized application of industrial engineering to hospitals, which includes training from such fields as operations research, computer science, and management science with the aims of effecting cost containment, revenue

enhancement, quality improvement, and productivity improvement (drawn from Refs. 2 and 5). The importance of management engineering to the benefits realization process is also emphasized by Freeman and Overton (Ref. 2). Hodge notes that the "timing of the benefits realization process is important. If [saved work] is not promptly translated into cost savings via staff adjustment, the saved time will be diverted into new activities. In a short time these new activities will come to be regarded as essential, and the opportunity for savings is lost" (Ref. 5, page 176). Specific functions of the benefits realization team are discussed below.

- Exploration of possible areas of unused potential by all levels of management. System performance should first be compared to the objectives of ADP implementation to determine in what areas the computer has fallen short of the expectations of system planners. Administrators can then analyze available data on system performance and utilization to identify efficiency bottlenecks, underutilized system functions, inappropriate staffing levels, etc.

- Feedback from users regarding areas of unused system potential. Not all sources of system potential are directly apparent, and the reasons for underuse may be even less observable. Users can often provide excellent insight as to what areas can provide additional benefits and whether or not functions have been underused or even unused due to understaffing, unfamiliarity with the system, design complexity, policies, etc. Ainsworth (Ref. 1) and numerous other authors have stressed the importance of user participation in every phase of the computerization process.

- Task observation by the benefits realization team. The primary functions of the benefits realization team as described by Hodge (Ref. 5, page 176) are to observe a given system-related task or work routine and to determine for each task observed if:
  - the task can be eliminated
  - the task can be combined with another task
  - the task can be done by a worker of a lower skill level
  - the task can be shifted in time to a slack period
  - related policies can be changed to simplify the task.

  These functions are best performed by a management engineer with a member of the staff being observed (a Registered Nurse, for example, if a nurse's station is being studied).

- Testing of possible solutions to greater benefits realization. The strategies developed to take advantage of unused system potential (e.g., changed procedures, additional terminals, faster printers, revised output formats, etc.) should be tested within the hospital on as small a scale as will still yield valid results in order to minimize costs and disruption of regular activities until their advantages have been demonstrated. Testing should be closely observed by the benefits team and should be fully explained to those affected personnel so that misunderstandings do not arise concerning the changes to be made or the reasons for such changes.

REFERENCES

1. Ainsworth, W., "The Primacy of the User," Infosystems, April 1977, pp. 46-48.

2. Freeman, J. R. and Overton, R. G., "Data Systems and Management Engineers Work Better Together," Information Systems, Vol. 51, October 16, 1977.

3. Gall, J. E., "Introduction of a User-Oriented Total Hospital Information System into a Community Hospital Setting—Tactical Management Revelations," Proceedings from the 1974 Medinfo Conference, North Holland Publishing Company, 1974.

4. Hodgdon, J., Interview Evaluation of the DataStat Outpatient Pharmacy System at Naval Regional Medical Center Charleston, HSDN 78-2, Analytic Services Inc., July 1978.

5. Hodge, M. H., Medical Information Systems: A Resource for Hospitals, Aspen Systems Corporation, 1977.

6. Tolbert, S. T. and Pertuz, J. L., "Study Shows How Computerization of an Intensive Care Unit Affects Nursing Time Spent in Direct Patient Care," Hospitals, Vol. 47, No. 2, April 1976.

V. SUMMARY

This report outlines the potential positive and negative impacts that a hospital should anticipate in adopting an automated information system, discusses the problem of resistance to change and its implications, and presents guidelines for use by military health care system administrators in successfully planning and managing a changeover to automated procedures. The management strategies suggested in Chapters III and IV of this report for realizing the planned benefits of automation are listed below:

Pre-Implementation Period

- Maximize user involvement in the planning process and obtain the cooperation of supervisors and opinion leaders
- Keep planner and user communication channels open and utilize meetings and newsletters to produce realistic user expectations concerning the ADP system
- Arrange visits for managers and users to a hospital with a similar system
- Train users immediately before installation of the new system, and maximize user involvement in conducting the training
- Select the most appropriate method of system conversion, and prepare a good backup system and debugging schedule
- Consult users regarding the timing of ADP installation, and avoid installing the system during or just prior to a period of peak seasonal workload.

Implementation Period (first year of system operation)

- Optimize the length of the transition period, maintain the same or greater staffing level, minimize staff turnover if possible, and allow but not require continued use of the old system
- Assign to the hospital a system implementation team consisting of a public relations specialist, an ADP troubleshooter, and an appropriate user (all preferably in-service) familiar with the specific system
- Maintain effective communication between the users and the ADP personnel
- Conduct on-going user training to improve proficiency and orient new staff members
- Conduct fireman maintenance of the system to avoid escalation of problems through delays between detection and correction.

Post-Implementation Period (1 to 3 years after system installation)

- Form an in-hospital benefits realization team consisting of an administrator, management engineer, and staff member (from the user group) to coordinate the benefits realization process
- Explore possible areas of unused system potential by analyzing ADP performance data to identify efficiency bottlenecks, underused functions, inappropriate staffing levels, etc.
- Obtain feedback from users regarding unused or underused system functions due to understaffing, unfamiliarity, design complexity, policies, etc.

- Task the benefits realization team with observing selected system-related activities to determine whether the tasks can be eliminated, combined with other tasks, done by a worker of a lower skill level, shifted in time to a slack period, or made easier by changes in policies or procedures
- Test possible means of realizing greater benefits on a small scale before introducing them widely.

Successful implementation and benefits realization of any hospital automated information system is a major accomplishment on the part of the planners, administrators, and staff members involved. We hope that this report will assist military health care system managers at all levels to understand and minimize the problems that may be encountered at various stages of the transfer from manual to automated operations.

PRIMARY DISTRIBUTION LIST FOR HSSEDN 79-1

Organization	Number of Copies
AFMSC/SGSE	30
Defense Documentation Center	2
ANSER	
Library	7
Reserve Stock	261

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER HSSEDN 79-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) PREPARATION FOR AND IMPLEMENTATION OF AUTOMATED HOSPITAL INFORMATION SYSTEMS		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER HSSEDN 79-1
7. AUTHOR(s) Jonathan D. Hodgdon Daniel J. Hutchinson		8. CONTRACT OR GRANT NUMBER(s) F49620-77-C-0025
9. PERFORMING ORGANIZATION NAME AND ADDRESS Analytic Services Inc. 400 Army-Navy Drive Arlington, VA 22202		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS AFMSC/SGSE Brooks AFB San Antonio, TX 78235		12. REPORT DATE January 1979 13. NUMBER OF PAGES 64
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Hospital Information Systems: Automated Hospital Information Systems
Impact of ADP Systems: Implementation of ADP Systems
Resistance to Change: User Resistance to Automation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is intended to serve as a reference guide for military health care system managers at all levels in the planning, implementation, and benefits realization of automated hospital information systems. Chapter I defines the types of hospital automatic data processing (ADP) systems and the concepts associated with the transition from manual to automated operations. Chapter II describes characteristic impacts (both positive and negative) of

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

ABSTRACT (continued)

an ADP system on the overall operation of the affected hospital department(s), and on the various categories of personnel within the hospital. Chapter III discusses the problem of resistance to change and its implications, and presents management strategies for minimizing problems that might occur either before or soon after installation of the new system. Chapter IV identifies common sources of unused system potential and suggests post-implementation strategies for realizing the full potential of the ADP system. Among the strategies recommended and discussed are: (1) user involvement in the planning process; (2) formation of a system implementation team; and (3) formation of a benefits realization team. The report cites lessons learned from previous military and civilian experiences with hospital ADP implementation as well as general literature relating to adoption of innovation.